## 5.1 Introduction

This chapter outlines the travel behavior forecasts used in conjunction with the land use forecasts (from Chapter 4) to develop forecasts of future travel and traffic in Boulder.

## 5.2 Travel Behavior Forecast

The forecast scenarios introduced in Chapter 3 explore the extent to which the City could manage transportation issues by changing or influencing personal travel behavior of those who live, work and shop in Boulder Valley.

There are many dimensions of personal travel behavior, including number of daily trips, average trip length, trip purpose, vehicle occupancy, and mode of travel (mode choice). Of these, Boulder has focused its policy intervention primarily on mode choice.

There are other variables to consider, including for example, how many trips people make. However, the City encourages people to carpool, use public transit, walk or bike, rather than drive alone. This approach addresses not how much travel occurs, but by what means. Thus, overall mobility need not decrease.

Figure 5-1 shows the travel behavior basis for the TMP Update forecasts. Scenarios A and B assume 2020 mode choice is the same as in 1994. Scenarios C, D and E are based on a shift in travel behavior away from SOV travel.

The amount of mode shift shown in the third column of figure 5-1 was set at a level which would cancel out motor vehicle traffic growth. These mode shares later became the basis for the goals and objectives information presented in Chapter 3. The exact split between non-SOV modes is not as important in this figure as the amount of reduction in SOV.

Following City Council study sessions in November, 1994, January, 1995 and May, 1995, Scenario D was adopted as the planning basis for development of the TMP Update.

figure 5-1. travel behavior forecasting basis

(% of daily person trips)

| MODE: | 1994 actual | "no intervention" 2020 A & B | "intervention" 2020 C, D, E |
|---|---|---|---|
| SOV* | 44 | 44 | 25 |
| MOA** | 22 | 22 | 29 |
| Ped | 19 | 19 | 24 |
| Bike | 11 | 11 | 15 |
| Transit | 4 | 4 | 7 |
| Total | 100 | 100 | 100 |

* single-occupant auto
** multi-occupant auto

## 5.3 Travel Forecasts

One fundamental measure of traffic and travel activity is daily vehicle miles of travel - VMT. A "vehicle-mile of travel" is defined as one motor vehicle traveling one mile within Boulder Valley.

All other things being equal, programs which decrease the proportion of daily trips made by single-occupant vehicles would decrease daily VMT, with resulting favorable impacts on traffic, congestion and air quality.

At the same time, underlying population and employment trends could overwhelm these shifts with the result that VMT would continue to grow even as the population makes increased use of alternative modes. Similarly, increased trip lengths and daily per capita travel could cancel out the benefits of mode shifts.

Thus, VMT provides one useful measure of what is actually happening on Boulder's streets. VMT is also an important predictor of mobile source emissions (see Chapter 9).

Figure 5-2 indicates daily VMT will increase substantially by 2020 if nothing is done to prevent this. While this may appear to be a major increase, it represents an average (straight line) rate of growth of only 2.1% - lower than the actual rate of growth in recent years (in Boulder Valley).

On the other hand, the intervention scenarios (C, D, E) would hold 2020 VMT at or below 1994 levels. This suggests that preventing increases in VMT is at least physically possible - primarily through travel behavior changes that reduce reliance on single-occupant vehicle travel. These travel behavior changes can be encouraged by providing attractive options to

figure 5-2. vmt forecasts

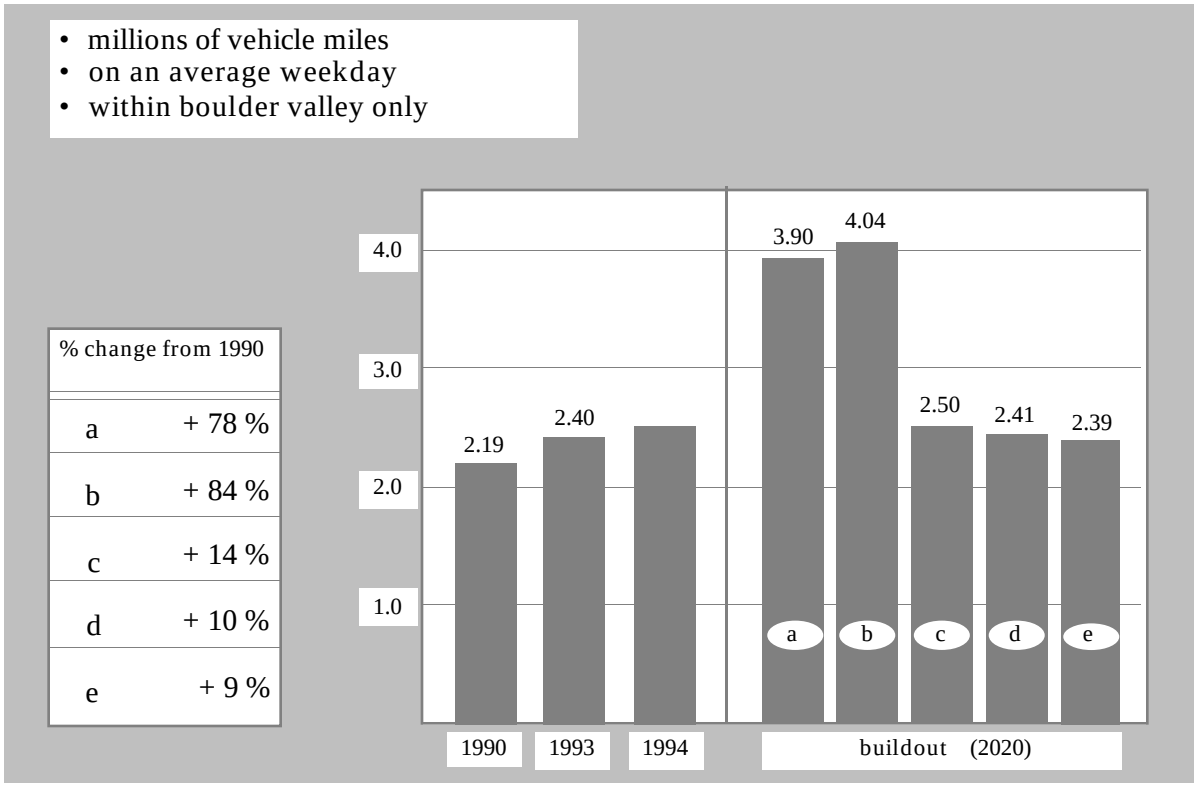
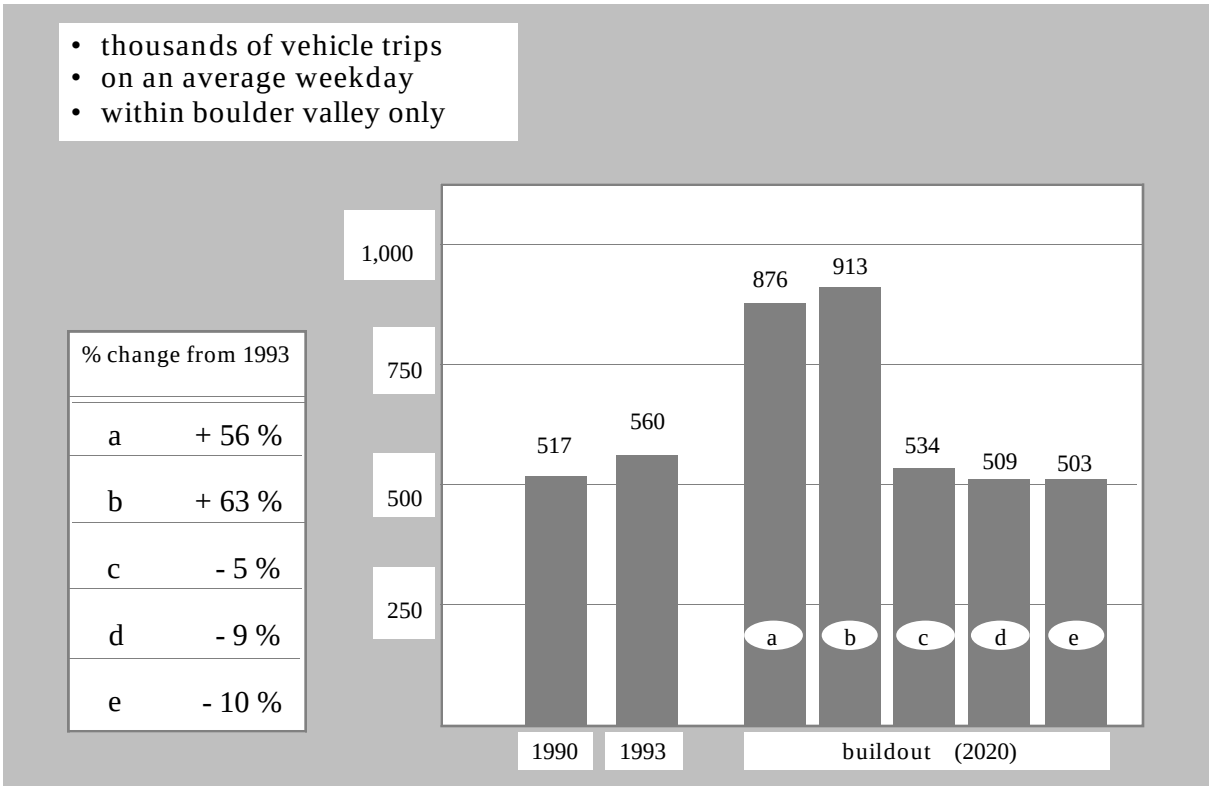


figure 5-3. vehicle traffic forecasts




single occupant-vehicle travel through use of the toolbox shown in section 1. This toolbox includes: investment in alternative modes; incentives and marketing; regulatory demand management; urban design; education and enforcement; partnerships; market-based strategies; and, telecommuting and tele-travel.

For many, "vehicle miles of travel" may seem like an abstract measure and may fail to paint a clear picture. "Vehicle traffic" (shown in figure 5-3) is an alternative measure, one that is more directly-related to what we observe on the street. It is defined as the average number of daily vehicle trips within Boulder Valley.

This provides a direct measure of how much traffic is flowing on Boulder Valley streets. It can be checked against data the City collects each year on the "average daily traffic" on Boulder's streets (see Chapter 2).

Figure 5-3 indicates that traffic, if unchecked, could increase by more than half by 2020. The percentages in figure 5-3 are lower than those in figure 5-2 because average trip lengths are expected to increase.

For this reason, holding VMT at 1994 levels may actually require reductions in daily vehicle trips. (If trips are longer, on average, and overall VMT is not to increase, then the number of trips must be less.) Thus, in Scenario D, which forms the basis for the TMP Update, the number of daily vehicle trips impacting Boulder Valley is actually 9% less in 2020 than it was in 1993.

However, another important facet of the traffic problem is illustrated in figure 5-4 on the next page. The forecasts indicate that the makeup of future daily vehicular traffic in Boulder Valley will change - under all

scenarios - with "external" trips becoming a larger component of the daily traffic stream.

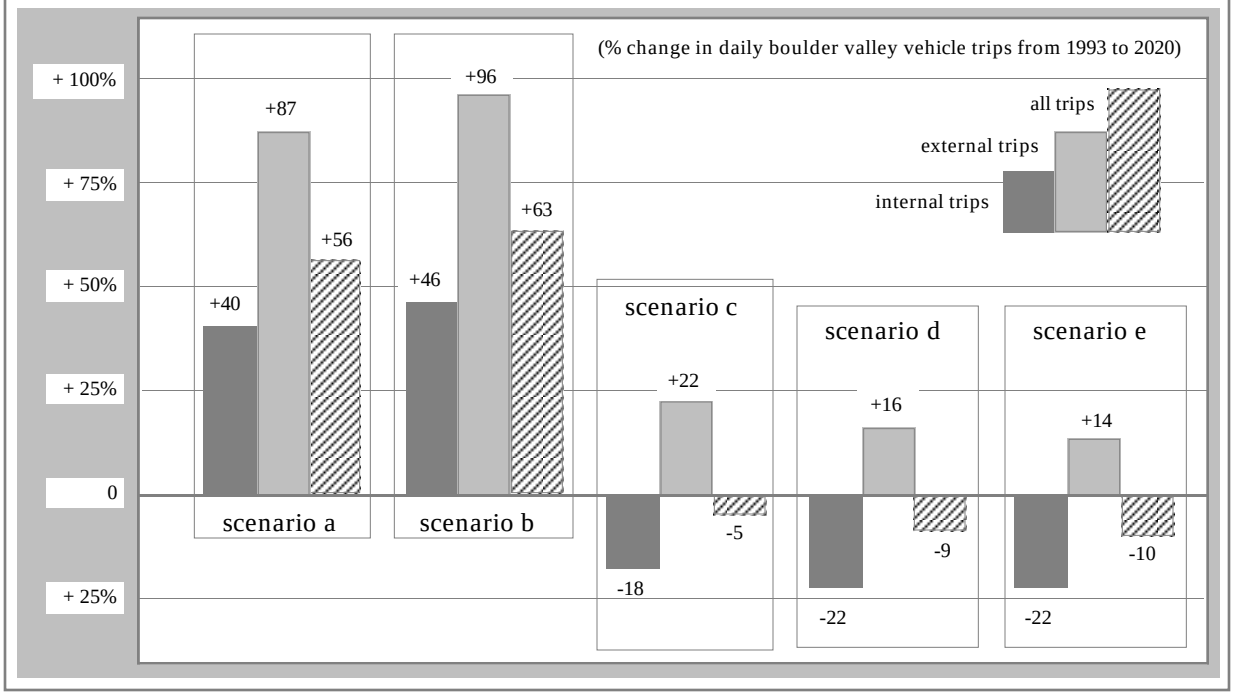
"External" traffic is defined as having one trip end (either origin or destination) outside of Boulder Valley. "Internal" trips both begin and end within Boulder Valley.

Under scenarios A and B, all traffic grows, although external traffic increases more than internal traffic.

the number of households in Boulder County outside of Boulder will more than double by 2020. Thus, there will be substantially increased travel throughout Boulder County. Many of these trips will come into Boulder for employment, recreation or shopping purposes.

As mentioned earlier, there is some risk associated with the degree to which regional land use decisions will impact Boulder's streets. There is currently no coherent regional strategy

figure 5-4. comparison of internal and external traffic




In scenarios C, D, and E, internal traffic decreases (primarily due to shifts in mode choice). However, external traffic continues to grow, although at a lower rate.

This illustrates the important role regional growth and travel will play in the transportation challenge in Boulder. If the City is to prevent increases in VMT and daily traffic, regional cooperation and policy-making will be required.

Boulder County population forecasts indicate

to address transportation and land use issues. However, a number of opportunities exist to establish regional partnerships with the county and neighboring communities.

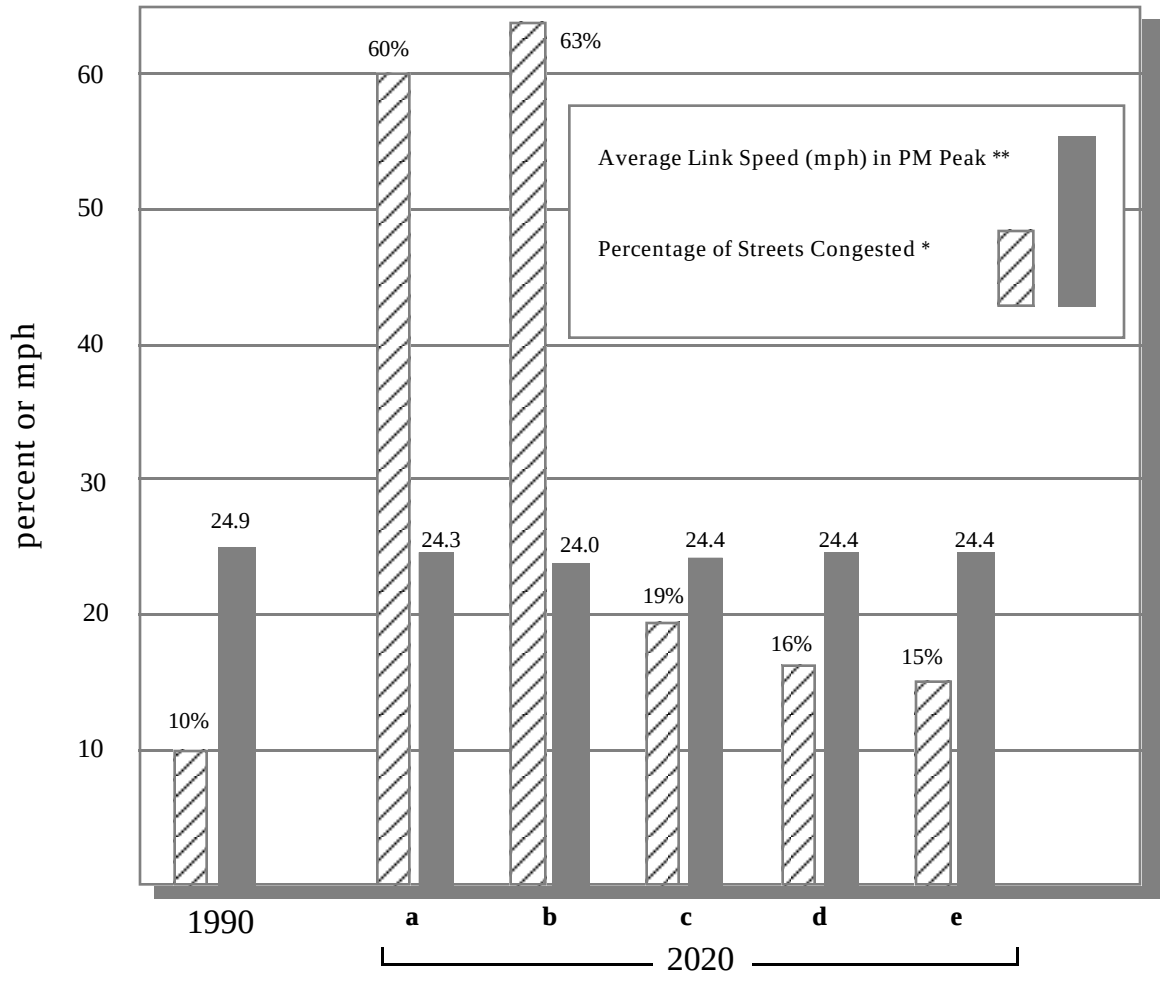
If residents of neighboring communities continue to be substantially auto-dependent, this will impact the entire region. For this reason, it is essential for Boulder to work cooperatively with its sister communities and with Boulder County to reduce auto-dependence and to help assure the availability of feasible, convenient travel options throughout the region.

The TMP scenarios also make possible forecasts of future congestion on Boulder's roadways. Here, the differences between alternative futures are pronounced. Under scenarios A and B, congestion on major streets would be much worse in the future than today.

Nearly two-thirds of our roadways would be congested (operating at level of service F during peak periods). Both the percent of system congested and the average speeds shown in figure 5-5 may be somewhat understated since they do not fully reflect the effects of traffic signals on intersection capacity.

The situation indicated for scenarios A and B might be described as widespread congestion and delay throughout Boulder for much of the morning and afternoon of every weekday. The conditions forecast for scenarios C, D and E appear more acceptable. The forecast for Scenario D is in fact about the level of congestion found in Boulder Valley today.

## figure 5-5. congestion forecasts




* % of 475 lane miles of freeways, expressways, major & minor arterials and collectors. Does not include local streets.
** Link speeds calculated by the traffic model. Does not reflect signal timing or average speed counting time spent at stop lights.

## 5.4 Evaluation of Travel Markets

This section reviews the specific travel markets that make up future vehicular travel in Boulder and assesses what strategies should be targeted to those markets in order to accomplish the TMP objective of no increase in vehicular traffic.

All of the data in this section relates to vehicle trips, not person trips, since the primary source of the data is the traffic model. One "vehicle trip" is made by one vehicle regardless of the number of occupants. Each link in a journey is counted as a "trip." Hence, leaving the office and making two stops on the journey home constitutes three trips.

The categories of travel market evaluated below are broken down into three origin/destination pairs and three trip purposes. The origin/destination pairs are:

Boulder Valley to Boulder Valley. These are internal trips with both ends in Boulder Valley.

Boulder Valley to Outside. These are trips that originate in Boulder Valley and travel to destinations outside Boulder Valley, along with their associated return components.

Outside to Boulder Valley. These are trips originating outside Boulder Valley and traveling to destinations within Boulder Valley, along with their associated return components.

The trip purposes are:

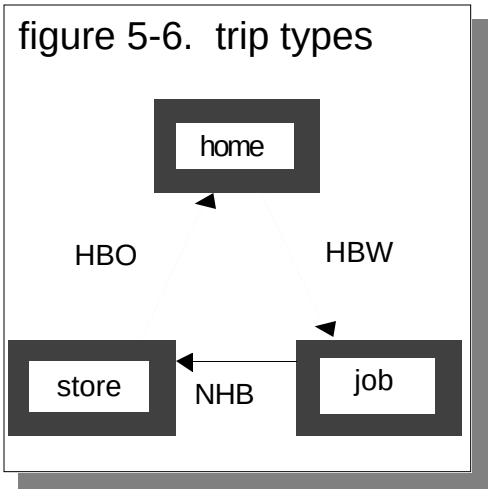
HBW (Home-based work). These are trips that move directly from home to work or from work back home. These are commute trips with no intermediate stops.

HBO (home-based other). These are trips from home to a destination other than work or from some activity other than work back home. Included here are shopping, recreational and social trips. Some of these trips are links in a journey from work to home or home to work. However, many are round trips from home which do not involve commuting. This is the largest and fastest growing category.

NHB (Non-home-based). These are trips with neither end at home. They include middle segments of commute journeys and a variety of other mid-day, work-related and other travel.

Figure 5-6 provides a simplified description of a journey composed of three trips, one in the morning and two in the afternoon.

figure 5-6. trip types




In addition to these categories of trip purpose, the data used in developing the TMP Update also includes vehicle trips made by commercial trucks and vehicle trips which have one end (either origin or destination) completely outside the Denver region.

These "Other" trips represent 11 to 12% of daily vehicle trips. They are generally poor candidates for mode shift or other behavioral adjustments.

This TMP Update is predicting that most of the change in travel behavior required to achieve a "no growth in traffic" outcome must come from the three trip purposes shown in the graphic. Very little of the shift will come from changes in "other" trip travel behavior

## Boulder Valley to Boulder Valley

Vehicle trips with both ends in Boulder Valley are made both by Boulder residents and by residents of neighboring communities.

This category represents about 66% of all daily vehicle trips today and will be 59% of vehicle trips by 2020.

1993 Daily Trips

370,000 -- of which 38,000 fall into"Other."

2020 Scenario A Daily Trips

517,000 -- of which 45,000 fall into"Other."

Market Characteristics

These are relatively short trips made by residents and by people with jobs in Boulder. These travelers have high familiarity with the local transportation system.

Over a third of these trips have neither end at home, as shown in Figure 5-7.

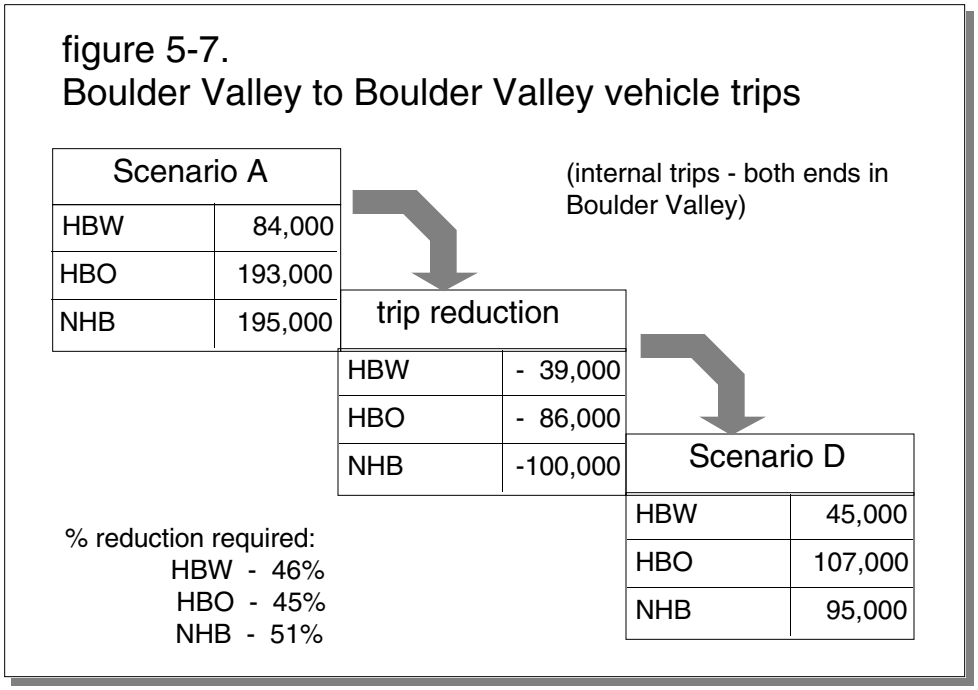
High Yield Strategies

Because they average less than 4 miles in length, these trips represent good candidates for walking and biking . They will also use high level-of-service local transit routes for those trips longer than a few blocks. They tend to be poor candidates for ridesharing because of their short length and because many of them are part of complex journeys.

This TMP Update proposes to reduce the number of these vehicle trips made in 2020 by 45% to 51% below Scenario A. This would place well over 200,000 daily person trips onto sidewalks, bicycles and local transit routes.

The most important strategy in accommodating this outcome would be improvements in the safety, quality and functionality of the pedestrian environment in Boulder's commercial and institutional areas, followed closely by improvements to the bicycle system . Marketing programs for Boulder residents and employer-based demand management would also be priority approaches.

figure 5-7.
Boulder Valley to Boulder Valley vehicle trips



## Boulder Valley to Outside

Vehicle trips which are part of journeys that begin in Boulder Valley, go somewhere else, and return are made primarily by Boulder residents.

This category represents about 9% of all daily vehicle trips today and will still be about 9% of vehicle trips in 2020.

1993 Daily Trips

50,000-- of which 9,000 fall into "Other."

2020 Scenario A Daily Trips

76,000 -- of which 13,000 fall into "Other."

Market Characteristics

These trips are part of relatively long journeys by Boulder residents as shown in Figure 5-8. Interestingly, over 40% of these are non-home-based trips such as mid-day business travel.

High Yield Strategies

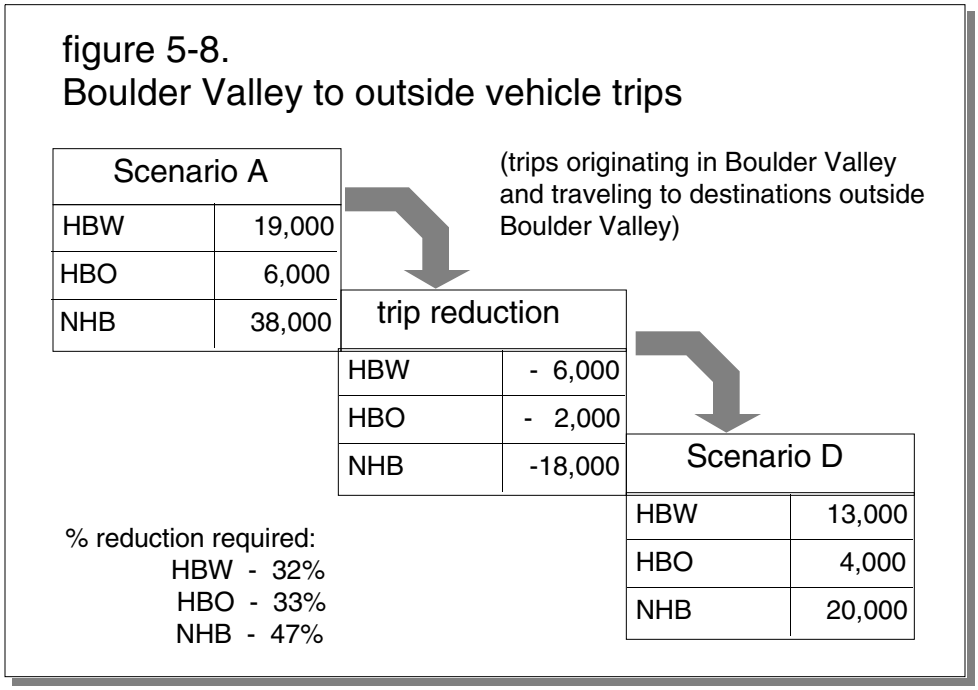
Because they are relatively long trips (4 to 30 miles), this category will not be heavily impacted by walking and biking strategies.

This category will also be challenging because about 70% of the behavioral shift should come in the non-home-based category. The greatest potential impact may be through encouragement of ridesharing . This is a low-cost strategy, but would require reversal of a long-standing trend toward lower average auto occupancies.

Employer-based and neighborhood-based demand management would be important in this category.

Modest increases in regional transit service in the US 36 corridor would be required, and these increases should focus primarily on service out of Boulder in the morning and back into Boulder in the afternoon (the current service orientation).

figure 5-8.
Boulder Valley to outside vehicle trips



## Outside to Boulder Valley

Vehicle trips which are part of journeys that begin outside Boulder Valley, come to a local destination, and leave again are made primarily by residents of neighboring cities. This category represents about 25% of all daily Boulder Valley vehicle trips today but would climb to about 54% of vehicle trips in 2020 (under Scenario A). As such it is the fastest growing category of Boulder Valley travel.

1993 Daily Trips

140,000-- of which 22,000 fall into "Other."

2020 Scenario A Daily Trips

279,000 -- of which 38,000 fall into "Other."

Market Characteristics

Many of these trips are part of relatively long journeys by residents of neighboring cities as shown in Figure 5-9. A fourth of them are home-based work and many of the home-based other trips are links in complex commute-oriented journeys. Other trips in this category are shopping trips to the Downtown Mall and to Crossroads, and recreational trips to local attractions.

Much of the (Scenario A) growth would come from increasing populations of East Boulder County cities and towns. This traffic would cause increased congestion on such east-west roadways as the Longmont Diagonal, Arapahoe, and East Boulder Road.

High Yield Strategies

Because they are relatively long trips (4 to 30 miles), this category would not be heavily impacted by walking and biking strategies.

Priority strategies should include employer-based and neighborhood-based demand management and increased ridesharing. However, achieving the required inroads into the commute portion of this market would also require significant improvements in regional transit service into Boulder from the east, southeast and south.

figure 5-9.
outside to Boulder Valley vehicle trips

| Scenario A | |
|---|---|
| HBW | 69,000 |
| HBO | 134,000 |
| NHB | 38,000 |

(trips originating outside Boulder Valley and traveling to destinations within Boulder Valley)

| trip reduction | |
|---|---|
| HBW | - 16,000 |
| HBO | - 61,000 |
| NHB | - 19,000 |

| Scenario D | |
|---|---|
| HBW | 43,000 |
| HBO | 73,000 |
| NHB | 19,000 |

% reduction required:
HBW - 23%
HBO - 46%
NHB - 50%

## 5.5 Cost-Effectiveness Evaluation

The previous section will provide a basis for continuing evaluation of travel markets and for an assessment of the best strategies for serving them. Specifically, the City will develop the capability to assess strategies in terms of their cost effectiveness.

Cost-effectiveness analysis will be utilized to determine, given a basic set of objectives, what the least expensive means of achieving the objectives will be.

This is a better approach than benefit-cost analysis for several reasons. First, in transportation planning, many of the most important benefits are virtually impossible to estimate. The value of cleaner air, the value of fewer traffic deaths -- these are things that are difficult to measure meaningfully. While it may be possible to assign dollar values to such benefits, the result is a misleading level of precision.

Second, benefit-cost analysis assumes that there is an unlimited sum of funds to invest, and the only question is maximizing net benefits. However, that is clearly not the case with the City's transportation budget (see Chapter 8).

It is much more useful to accept the fact that budgets are limited and to seek ways to achieve the City's objectives at lowest cost. That is what cost-effectiveness analysis does.

Until recently, the data required to undertake cost-effectiveness analysis of the transportation program has not been available. For example what is the cost to RTD to provide a transit trip in Boulder? What is the cost, per person trip, of providing a more efficient roadway system? What is the cost of improving the bicycle network, expressed in terms of person trips?

As part of the Congestion Relief Project which has been undertaken by the City, the cost of travel by mode is being estimated. This will provide a basis for further analysis of the cost-effectiveness of alternative solutions to the needs summarized in Chapter 8.

The City will work to develop a process for evaluating its future transportation budgets and capital programs for cost effectiveness using this and related data sources.